

Exploring the Utilization of Low-Pressure, Piston-Cylinder Experiments to Determine the Bulk Compositions of Finite, Precious Materials

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Determining the bulk composition of precious materials with a finite mass (e.g., meteorite samples) is extremely important in the fields of Earth and Planetary Science. From meteorite studies we are able to place constraints on large scale planetary processes like global differentiation and subsequent volcanism, as well as smaller scale processes like crystallization in a magma chamber or sedimentary compaction at the surface. However, with meteorite samples in particular, far too often we are limited by how precious the sample is as well as its limited mass. In this study, we have utilized aliquots of samples previously studied for toxicological hazards [1] including both the fresh samples (lunar mare basalt NWA 4734, lunar regolith breccia NWA 7611, martian basalt Tissint, martian regolith breccia NWA 7034, a vestian basalt Berthoud, a vestian regolith breccia NWA 2060, and a terrestrial mid-ocean ridge basalt (MORB)), and those that underwent iron leaching (Tissint, NWA 7034, NWA 4734, MORB). With these small masses of material, we performed low pressure (~0.75 GPa), high temperature (>1600°C) melting experiments. Each sample was analyzed using a JEOL 8530F electron microprobe to determine the bulk composition of the materials that were previously examined in [1]. When available, the results of our microprobe data were compared with bulk rock compositions in the literature. The results of this study show that with this technique, only ~50 mg of sample is required to accurately determine the bulk composition of the materials of interest. [1] Harrington, A.D., McCubbin, F.M., Kaur, J., Smirnov, A., Galdanes, K., Schoonen, M.A.A., Chen, L.C., Tsirka, S.E., and Gordon, T. (2017) Pulmonary inflammatory responses to acute meteorite dust exposures – Implications for human space exploration. 48th Lunar and Planetary Science Conference, The Woodlands, TX, #2922.